

ALLIS (O.H.)

UPON

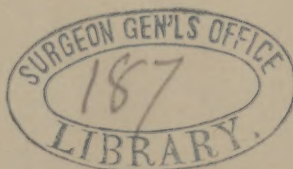
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THE DANGER FROM FRACTURES IN CLOSE  
PROXIMITY TO THE KNEE-JOINT.

BY

OSCAR H. ALLIS, M.D.,

SURGEON TO THE PRESBYTERIAN HOSPITAL IN PHILADELPHIA.



EXTRACTED FROM THE TRANSACTIONS OF THE MEDICAL SOCIETY OF THE STATE  
OF PENNSYLVANIA FOR 1881.

PHILADELPHIA:  
COLLINS, PRINTER, 705 JAYNE STREET.  
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## UPON THE DANGER FROM FRACTURES IN CLOSE PROXIMITY TO THE KNEE-JOINT.<sup>1</sup>

CASE I.—David H., 50, admitted to county hospital on account of fracture of the femur just above the condyles. There was some swelling and effusion into the knee-joint. The limb was dressed with long splints and extension. Two days later the patient complained of pain in the thigh, and an increase of swelling at the knee and seat of fracture. On the fourth day the pulse was 112; temp. 103°; patient sleepless in spite of opiates; anterior and posterior tibial arteries can both be felt pulsating strongly at the ankle. Has vomited and refused food. Fifth day pulse 112, temp. 101°, symptoms no better. Death on sixth day.

*Autopsy.*—On cutting into the thigh, blood poured out from the cellular tissue. No large collection of blood at any point, though generally diffused throughout the soft parts. The fracture was at the junction of the lower with the upper three-fourths. The autopsy was hurriedly made and the precise source of the hemorrhage not ascertained. Internal organs healthy. (*Med. Times and Gazette*, 1871, vol. ii. p. 10.)

CASE II.—Man, æt. 46, while pulling on his right boot felt something give way just above his knee. (This limb had been paralyzed for over a year, but was nearly restored at the time just referred to.) A surgeon was immediately summoned, who detected a fracture in the lower third of the femur. The limb was dressed in a long splint and left undisturbed for three weeks. He suffered considerable pain immediately after the dressing and during the time the splint was on, when, owing to an increase of the pain, he was sent to the hospital.

*Condition on reaching the hospital.*—Patient blanched; lips, tongue, eyelids extremely pale; pulse rapid and feeble; right limb enormously swollen throughout. Pain extreme, but greatest at the knee, from which it seemed to shoot. The knee was notably promi-

<sup>1</sup> For an exhaustive paper on this subject see 3d series, Guy's Hosp. Reports. By Poland.

ment, and above the knee a distinct depression was evident. The skin in front and to the inner side of the knee was reddened, and deep fluctuation could be obtained. Both tibial arteries could be felt. For the past week he has perspired profusely, but had no rigors. An exploratory operation was made by Mr. Heath, and finding no pus, a consultation was called, the limb removed, and death followed in three days.

*Examination of the limb.*—Fracture very oblique and extending from just above the inner condyle to a point five inches above. There was a large amount of laminated blood, the source of which was from the popliteal, the injury being the tearing off of one of the azygos arteries at its attachment to the main trunk. (*Lancet*, 1868, vol. ii. p. 246, University College Hospital.)

CASE III.—Benj. M., 18, was thrown from his horse and dragged some distance, injuring knee and shoulder. On examination the latter was found to be slight, while the injury to the knee was regarded as a complete lateral dislocation with four inches of shortening. It was easily reduced, but would not remain in position until after the third reduction, when it stayed in place and was dressed on a long splint.

For a few days the case did well, but then violent inflammatory symptoms set in, and, fearing gangrene, other advice was sought, and the limb amputated in the lower third of the femur. The boy made a good recovery. Six weeks later the amputated limb was exhumed, and the injury found to have been a separation at the lower epiphysis of the femur. A suit for malpractice was accordingly instituted, and damages to the amount of \$750 and cost of suit adjudged.

CASE IV.—This remarkable case was furnished me by Dr. J. H. Fishburne, of Lock Haven, Pa.

John McV., 48, wood-chopper, injured by the falling of a tree. Sustained a transverse fracture of the femur just above the joint. Treated in the usual manner for twelve weeks, when the case came for the first time under the care of Dr. Fishburne, who found the entire limb below the fracture in a singularly abnormal condition. "The lower portion of the bone and the knee-joint was a crispy nodulated deadened mass; the whole lower extremity was shrivelled, resembling a dried lifeless anatomical specimen." Having satisfied himself that the limb was an incumbrance, and that there was no possibility of reclaiming it, amputation was resorted to and followed by a good recovery.

*Dissection of the limb.*—The soft parts literally metamorphosed; no soft tissue left save the dried shrivelled parts. The bloodvessels were like so many brittle, or cheese-like strings. The bones were of



a darkened, slightly brownish color, exceedingly brittle, with the medullary tissue all dried up. The arteries at the seat or point of fracture were torn or destroyed. The shrinking away began immediately below the line of fracture, and the flesh fell abruptly away from nearly normal fulness to a skeleton-like shrunken condition.

CASE V.—H. B., 48, slipped on an orange-peel and fractured the lower third of the femur. It was dressed upon an American swing splint. Ten days later he was attacked with pneumonia, and thirteen days later (twenty-three from the injury) pus was discovered about the fracture. This was twice aspirated, and, collecting the third time, was laid open and a drainage tube inserted. The wound healed, and the man left his bed about three and a half months after the injury.

About two weeks later he refractured the bone at the same point; a second abscess formed, which was freely opened and followed by a speedy cure. (*Lancet*, 1871, vol. i. p. 153, St. Bartholomew's Hospital.)

CASE VI.—James Bennett, R. R. engine driver; was precipitated with his engine down an embankment twenty feet. He was immediately removed to the Chesterfield Hospital, when upon examination a simple comminuted fracture was detected in the lower third of the right thigh—and a long splint applied.

A few hours later the surgeon of the R. R. visited the hospital and approved of the treatment. The limb swelled rapidly, and on the visit of the surgeons of the hospital, Drs. Jones and Black, on the following day, they found the dressing had been removed and the limb resting on a pillow. The swelling was below the knee, while the toe, instep, and ankle were below the normal temperature. The skin presented patches of livid discoloration, particularly about the lower part of the calf, and several bullæ had arisen on the dorsum of the foot and lower part of the leg. These symptoms suggested an injury *below the knee*, but, as in the original examination none was found, the suspicion was laid at rest. The symptoms, however, grew daily worse, and gangrene declared itself on the sixth day. On the seventh day, through the sloughing structures, a fracture of the tibia below the knee was noticed. On the ninth day the limb was amputated, but death followed on the next day.

*Examination of the limb.*—Fracture of the tibia two inches below the knee-joint, and a fracture of the fibula one inch lower. The posterior tibial artery and the venæ comites were ruptured. (*Lancet*, 1861, vol. ii. p. 227.)

CASE VII.—W. J. W., 52, a carpenter, was knocked down, and the wheel of a brick cart passed over his left leg, fracturing both

bones at the same level, a little below the tuberosities of the tibia. A good deal of blood was effused above and below the seat of the injury, and the limb was considerably swollen and bruised.

The limb was put up in splints and evaporating lotions applied. The fragments were not easily kept in position, a tendency to overlap being manifest at every movement of the patient.

For about two weeks and a half everything proceeded favorably, but at this time pain and swelling took place at the seat of fracture and an abscess pointed. From this a large quantity of fetid blood-stained fluid was evacuated. This was followed by considerable sloughing of tissue, and five days later the limb was amputated just above the knee. A good recovery followed. On dissection of the limb, the femoral artery was found plugged with fibrine. (*Lancet*, 1876, vol. ii. p. 638, London Hospital.)

CASE VIII.—As J. D., æt. 15, was wheeling a heavy loaded wheel-barrow, it tilted suddenly, and the right handle struck him a severe blow below the right knee, producing a fracture of the upper epiphysis of the tibia simulating an internal lateral dislocation. The fracture was easily reduced, a bandage applied from the toes upward, and lateral splints adjusted.

On completing the dressing the limb was found to be numb throughout its entire length, and much colder than its fellow. The dressings were therefore immediately removed and the limb placed upon cushions. The second day extensive vesications appeared all along the calf reaching to the popliteal space; the great toe and some of the small toes began to look livid. The foot and leg and especially the knee became swollen. On the third day the gangrene was more pronounced, and as the pain was excruciating, consent to amputation was given, which was followed by a good recovery.

*Examination of the limb.*—The fracture was at the epiphysis of the bones, and the veins were so injured that phlebitis had been set up by pressure upon their coats. The veins were plugged and impervious: the condition of the arteries is not given. (*Medical Times and Gazette*, 1871, vol. ii. p. 74.)

CASE IX.—John A., 82, slipped off the edge of a step, fell about two feet, and coming down upon his left leg bent it under him. The joint and surrounding parts swelled rapidly. On examination an oblique fracture in the upper third of the tibia was detected, with some comminution of the fragments. The fibula was also broken a little higher up.

Three days later the leg was blue and much swollen with many blisters upon it, though still warm even to the foot. The synovial cavity of the knee-joint was distended to its utmost capacity. He became delirious, and died on the twelfth day.



At the autopsy blood was found in the joint cavity, and was supposed to have found its way through the superior tibio-fibular articulation, since the fibular fracture communicated with it. Neither fracture communicated with the knee-joint. The cause of the gangrene is not stated. (*Lancet*, 1875, vol. i. p. 857, London Hospital.)

The remaining cases are interesting as showing a result similar to those previously recorded, though not accompanied by fracture.

CASE X.—Man, 25, was engaged in raising a heavy truck by means of a crowbar, when the bar slipped and struck him a violent blow on the front of the right thigh. This was followed by sudden and intense pain in the popliteal space, which almost caused him to faint. The pain measurably abated, and he resumed his avocation. Six days later he walked several miles, but a sudden seizure of pain in the knee forced him to obtain conveyance home. There was a gradual increase in the limb for about two weeks longer, when it ceased to swell, and a point of fluctuation was noticed in the ham, and on being opened clotted blood was found. He was admitted, five weeks from the injury, into St. George's Hospital, and, as the limb was cold, pale, and tensely swollen without pulsation below the knee, a large bleb existing on the heel, and a bloody fluid oozing from the popliteal region, amputation was resorted to above the knee, but death from pyæmia followed on the nineteenth day.

Dissection of the limb showed an incomplete rupture of the popliteal artery opposite the joint. The vein was uninjured. (*Med. Times and Gazette*, 1866, vol. i. p. 427.)

CASE XI.—W. W., 21, while walking down hill by the side of a loaded wagon, one wheel of which was locked, fell and the lower part of his right thigh was caught by this locked wheel. The wheel did not pass over the limb, but pushed it before it for some distance.

He was taken to the Great Northern Hospital soon after in a state of collapse. The limb (on examination) was found colder than its fellow, swollen above the knee, and pulseless below the knee. The limb soon began to change color, first becoming livid in the foot, and amputation was resorted to forty-nine hours after the accident. The case recovered.

On dissecting the limb, the popliteal was found ruptured just above the anterior tibial branch. (*Lancet*, 1876, vol. ii. p. 426.)

CASE XII.—Leah A., 71, fell, doubling the left leg under her; was taken home, but not doing well was sent a week later to King's College Hospital. Here the limb was found enlarged, painful, pulseless, and with a tendency to gangrene, but with no distinct progress. She died four days later.

*Examination of limb.*—Rupture of the popliteal artery and vein

opposite the joint, with effusion of blood into the popliteal space. (*Med. Times and Gazette*, 1868, vol. ii. p. 123.)

CASE XIII.—J. T., 40. While carrying a sack of wheat, he slipped and fell backwards, the sack falling upon his right thigh. He felt something give way just below the knee, and a swelling at once appeared behind the knee and in the upper part of the calf. He was unable to rise without assistance, but could straighten the leg. He was admitted the day of the injury to Guy's Hospital. On his arrival the leg and popliteal region were very hard, tense, and somewhat shiny. No pulsation could be felt below the knee; leg numb and temperature slightly elevated. The limb was dressed in cotton wadding. On the 7th day gangrene was declared, and the limb removed on the eleventh (he would not consent to it earlier). Recovery, though after a long and tedious confinement.

*Dissection.*—Anterior crucial ligament ruptured; popliteal artery and vein both torn across. (*Med. Times and Gaz.*, 1866, vol. ii. p. 6.)

The cases here represented are only a few typical ones from the multitude that could easily be collected. They have not been sought for, but merely noted in the pursuit of the general study of fractures. I have given them at some length, hoping thereby to arrest the attention of any who have hitherto given the subject no special attention. Not that I have anything new to offer, but rather because I feel satisfied that the danger in this class of injuries is greatly underrated.

All writers upon fractures near the knee-joint have stated that the chief danger is from hemorrhage; but none of them have cared to hazard the assertion that it was physically impossible to have a fracture in close proximity to the joint without having hemorrhage, often dangerous if not fatal.

The principle upon which such a statement rests lies in the disposition of the bloodvessels; and unless this is fully appreciated, a person might be led to make as favorable a prognosis in this class of injuries as in any other; while any one who had been fortunate in a single case thus injured would have little sympathy for others whose results were less favorable.

To illustrate let me refer to a few anatomical points. The femoral artery on emerging from the canal of Hunter takes its course close to and behind the lower end of the femur and upper end of the tibia. The course and branches of this artery must be noted; it is placed behind the bend of the knee for protection and to accommodate itself to the motions of the limb. A glance at any anatomy will give the plan and number of the arteries. There are three pairs



making six branches in all, three on each side. These branches pass off at nearly right angles to the main trunk and anastomose with each other on the front of the knee. It is evident that one function of these branches is to hold the main artery in its median course. Below the articulation a branch of considerable size, the anterior tibial, makes its way between the head of the fibula and tuberosity of the tibia to supply the soft structures upon the front of the leg, while the terminal branches are soon lost in the muscular structures of the calf and foot. It is plain from this arrangement, that, while the main artery is guarded against injury from the front, and securely stayed and held in the median course by its numerous branches at this point, yet it is also evident that it must be in great peril when the lower portion of the artery is carried suddenly and forcibly away from the upper portion, as must be the case in all fractures in this locality.

As my main point is, not that hemorrhage, but that *dangerous hemorrhage*, is likely to follow injuries here; not that it may occasionally occur, but that it is *always to be apprehended*, I shall offer no apology for further illustrating it. In Fig. 1, I represent an

Fig. 1.



Diagrammatic—showing the arteries put upon the stretch when fracture with overlapping occurs above the joint.

oblique fracture just above the knee. The upper fragment is below, and the lower above the normal attachment of the arteries; and when such a change in the relation of the bone takes place suddenly and forcibly, when the bone, so to speak, suddenly expands to twice or three times its normal diameter, when the distance between two branches is suddenly increased two, three, or four inches, is it not evident that such sudden, violent, forcible change must be at the expense of the vessels that surround the part? The rupture, if in the branches, may be at a distance from the main trunk, and in all such cases the hemorrhage will be trifling; but it will be noticed



(Fig. 1) that not one but several branches are involved, and, if the rupture in a single branch occur close to the parent trunk, then the hemorrhage will be fatal to life or limb.

When the fracture occurs just below the knee, the danger will be similar in nature but more inevitably serious. Here the sudden

Fig. 2.



Diagrammatic—showing the arteries put upon the stretch in fracture with overlapping below the joint.

separation produces tension upon one of the terminal tibial arteries, and the anterior tibial, passing through as it does between the bones to the front of the leg, cannot accommodate itself to the sudden tension, and is therefore the more liable to rupture, and hemorrhage from an artery of this size would be as mischievous as from the popliteal itself.

Although the anterior tibial is in great jeopardy from fractures just below the knee, yet the overlapping of fragments, when the fracture is in the femur, may be just as trying to its integrity. In Fig. 3 I represent an epiphyseal separation possibly similar to the one described in Case III.

Fig. 3.



Diagrammatic—showing how a fragment of the femur may rupture arteries below the joint.

There are still injuries, whose remarkable fatality every careful observer and reader has noticed, that must be included among those

already described, viz., the epiphyseal disjunctions that are liable to occur at any time prior to mature life. I desire to call special attention to this injury, since authors have described it as one of no serious moment, and to the unwary it may seem not unlike the *separations* that safely occur in other parts of the skeleton. The facts of the case are directly opposed to so favorable a view. Hamilton gives half-a-dozen cases, and the case (III.) already reported shows that loss of limb is often the best compromise that can be made; and he who will take a growing bone, and note how the articular arteries lie parallel with and embrace the bones at these points, will not be at a loss for a solution of so grave a result. (See also Fig. 3.)

Fig. 4.



In the foregoing remarks I have taken but a few of the many injuries that may occur here. To appreciate the full extent of the danger one must picture the veins as numerous as the arteries, and to these add the nerves, all in the narrow compass of the popliteal space, and then subject them to the violence, tension, and laceration that accompany injuries that break the bone, breaking it not smoothly across but always roughly, often with sharp-cutting edges; sometimes cutting both artery and vein across; sometimes piercing one with a sharp fragment, or tearing or bruising them so as to render them no longer capable of acting as blood channels. Such possibilities, such strong probabilities are well worthy the most serious contemplation, for upon the full appreciation of these circumstances hangs the destiny of all thus injured.

*Treatment.*—No positive rules can be laid down. Everything will depend upon the degree, the character, and the gravity of the injury. In all the cases to which I have referred it will be borne in mind that the skin was unbroken, and the fracture the so-called simple variety. It is plain then that no diagnosis that will embrace the details of the injury, the precise lesions of arteries, veins, and nerves, can be made, and yet the life of the patient will depend upon a wise and intelligent course.

As soon as the patient has recovered from the shock the limb

should be examined under an anæsthetic. No judicious surgeon would add to the shock by instituting a careful, deliberate examination while the patient is still suffering from the depression of the injury. At the proper time, usually within twelve hours, this should be done, *i. e.*, the *examination under an anæsthetic*. I would make this a positive condition, nor would I consent to take charge of a case unless this privilege was conceded. Before the anæsthetic is given, the patient if of suitable age, and the family if not, should consent to the conclusion that may be arrived at by the examination. Such an arrangement will be to the advantage of all concerned.

In making the examination all unnecessary rudeness should, for obvious reasons, be especially guarded against; yet, the examination should thoroughly map out the line of fracture. The mistake of calling an epiphyseal separation a dislocation has been made, and a fracture of the tibia two inches below the knee has been overlooked when it coexisted with a fracture above the knee. No reliable diagnostic signs can be laid down; they will all vary with the injury and the interval between it and the examination. For this reason the anæsthetic should never be omitted. Crepitus will always be present with fracture. If the fracture is just above the joint it may simulate a dislocation, and if there is much swelling, the contour of the whole region will be changed. Let the swelling be ever so great the condyles of the femur can be felt in the semi-flexed limb; and if the point of crepitus is above them a fracture must be present. Having ascertained the injury to the bones, the attention should be directed to the circulation; this embraces (1) the arteries and (2) the veins. If the popliteal artery has been torn across, it is probable there will be no pulsation in the vessels below the knee. The popliteal may be uninjured, and the amount of blood effused within the popliteal space may so compress the artery as to render pulsation below too feeble for detection. It must thus be evident at the outset that nothing *absolutely positive* can be said of its condition. Some added information may be obtained by applying a bandage tightly to the feet, so as to drive all the blood out of them. After a few moments remove both bandages simultaneously. If the feet redden with equal promptitude a point in favor of the circulation has been established, while if retarded in the injured limb it may be from lesion or compression of the popliteal artery, or lesion or compression of the popliteal vein. The superficial veins of the lower extremity, and especially below the knee, are the main channels for the return current. If an occlusion in the popliteal vein occur below the knee-joint, the circulation will suffer no material loss, but if it become occluded above it the entire reflow must be



through the internal saphenous, and when this the only avenue of escape is blocked by excessive swelling, the early onset of gangrene is inevitable.

In estimating the gravity of the injury I should *cæteris paribus* deem a fracture just below the knee of graver import than one similarly situated above it. Again, if the original injury had been accomplished through great violence, as by a fall from a great height, or by being thrown from a rapidly moving carriage, so that the vulnerating force had not been expended in breaking the bone, but passed beyond to the soft parts, in all such injuries the prognosis must be far more unfavorable than when the injury was of a less violent order, even though the fracture in the bone be equally extensive. Finally, if the swelling has been rapid and the temperature below the knee be below the standard, the indications are that the injury is of a different and more critical nature than when the swelling comes on slowly or after the lapse of days.

It is highly probable that in the majority of such injuries the patient will not consent to the prompt removal of the limb, nor would the surgeon like to assume so great responsibility. Should conservative measures prevail—a term never used when the amputation of a limb saves a life—the dressing is of the utmost importance. A fracture-box on the principle of the double inclined plane will serve as a retentive apparatus for a pillow upon which the limb may securely rest and receive without further disturbance the medicated applications that may be indicated. In the absence of such a fracture-box I would strongly urge (but only as a temporary expedient) the simple use of pillows, for the limb may be cold and livid before another day, and if splints and bandages have been applied, there are not a few medical men who will assert with the utmost confidence that it was a case of tight bandaging. In the fracture-box the semiflexed position is most favorable to fracture just above or below the knee, and as the entire box can be suspended, there is much more to commend it than at first appears.

If swelling becomes excessive, the idea of punctures and free incisions might suggest themselves, but the probability is they would do no possible good. If there is good reason to think that the tension of the skin and underlying fasciæ should be relieved, then one continuous incision the entire length of the swollen mass down to or even through the deep fascia will relieve it, and nothing else will. If the swelling be attended with grave constitutional symptoms, then the question of immediate amputation assumes great magnitude. To delay for the line of demarcation should symptoms of gangrene arise, would be fatal to the case. Should symptoms of

septicæmia declare themselves, delay will only diminish the chance of recovery.

Not every form of swelling and pain should call for such extreme measures. The swelling may terminate in abscess and recovery follow, still what I urge is that if the injury is near the joint, this fact alone calls for unusual vigilance on the part of the medical attendant, who should be on the alert for every untoward symptom, give it its true value, and be prepared for extremest measures at a moment's warning.

On removing the limb, carefully examine and record the injury in detail; the character and position of the injury to the bone; the blood poured out; the injury to vessels and nerve; and injury to the tissues. As a further precaution, it would not be unwise to preserve the part removed or the injured specimens, as no one can foresee the amount of litigation that is in store for the surgeon.

Before leaving the general subject, I have a word to offer that has been suggested by three cases of injury in this region, two of which found their way into the courts, and the third was only saved therefrom by the prompt and decided action of a distinguished hospital surgeon. In two of the cases heavy damages were awarded, in one case (III.) they were wholly unjust, for though it was treated by an eclectic, there is no reason to believe that the result would have been more favorable in the hands of the most skilful. In all three the cases passed from the care of the original medical attendants into that of other medical men. In the first, suit was *threatened* because the limb was not promptly removed. In the second, the main charge was that an epiphysial disjunction had been mistaken for a dislocation. There is no evidence that the peculiar danger of this class of injuries was dwelt upon, but the mere fact that an error in diagnosis, not in treatment, had been made rendered him liable, though the treatment adopted would have been judicious had he known the precise injury. In the third case there was good reason to think from the character of the injury that amputation should have been resorted to at once. The fact that one is liable to be dismissed from a severe case at any time, should, especially in such an injury as this, prompt him to associate with him one who is both competent and willing to face the consequences either medical or judicial.

In conclusion, I would say—

1. Regard all fractures in the vicinity of the knee-joint as belonging to a class of special danger.
2. Examine all such fractures under an anæsthetic.

3. Amputate promptly if there is reason to believe the artery or vein is torn.

4. Make no hasty or favorable prognosis.

5. If an attempt is made to save the limb, place it in an easy, unconstrained but secure position.

6. Visit the patient frequently, and record the change from day to day.

7. If high constitutional symptoms arise, if gangrene or septicæmia threaten, delay will add nothing to the chances of recovery.

8. If the limb is removed, make a careful dissection of it in the presence of competent physicians, and record the result.

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